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FOREIGN AIR POLLUTION RESEARCH IN FINE PARTICULATES

by

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SUMMARY

The purpose of this program was to collect and translate unpublished Australian, Canadian, Japanese, New Zealand, and Soviet aerosol research reports as a means of identifying new concepts for fine particle control and measurement. About 300 reports each were collected from Japan and the USSR, and about 30 each from Australia/New Zealand and Canada. Eleven new concepts of fine particle control and three new concepts of fine particle measurement are listed below. Most of these new concepts are from the USSR and are for the modification and improvement of existing methods rather than fundamentally new methods.

New Control Concepts

1. Spouted Bed Collection of Electrified Aerosols
2. Scrubber with Magnetically Pretreated Water
3. Shock-effect Scrubber
4. Foam Scrubber with Pre-electrified Particles
5. Electrified Gas-dispersion Scrubber
6. Electrostatic Regeneration of Fabric Filter
7. Ion-exchange Fabric Filter for Liquid Aerosols and Gases
8. Twist Regeneration of Bag Filter
9. Three-field, Wet, Tubular Electrofilter
10. Magnetic Precipitator
11. Suppression of Dust Emission with Strong Electrical Fields at High Temperatures

New Measurement Concepts

1. Particle Mobility and Mass Measurement by Sound Waves in Electrical Fields
2. Low Pressure Centrifugal Aerosol Spectrometer
3. Particle Concentration Measurement at High Temperature by Thermal Radiation

I. INTRODUCTION

Fine particle aerosols (less than 5 μm diameter) emitted from stationary sources are extremely important to public health because the particles can pass through the upper respiratory tract, deposit in the lungs, and remain for long periods of time. In addition, fine particles remain airborne for extended periods, affecting visibility and weather. Fine particle emissions are also difficult to control and measure. The purpose of this study, therefore, was to collect Australian, Canadian, Japanese, New Zealand, and Soviet aerosol research reports as a means of identifying new concepts for fine particle control and measurement.

Reports were to be less than five years old, not formally published (not available to those working in the field), and not available through the Air Pollution Technical Information Center (APTIC). Foreign language reports were to be translated or abstracted, depending on importance. Translations were to be "rough" (as in initial draft form) as opposed to "polished."

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II. REPORT COLLECTION AND TRANSLATION

Reports were collected primarily by the following aerosol researchers:

Australia and New Zealand - Dr. Werner Strauss, U. of Melbourne

Canada - Prof. Jan Beeckmans, U. of W. Ontario

Japan - Prof. Koichi Iinoya, Kyoto U.

Additional reports were obtained by writing directly to other aerosol researchers. Papers from the following Japanese language journals were included because these journals are not listed in the July 1975 list of journals available to APTIC:

1. Atmospheric Electricity (Taiki Denki Kenkyu)
2. Crushing (Funsai)
3. Environmental Conservation Engineering (Kankyo Gijutsu)
4. J. Japan Health Physics Soc. (Hoken Butsuri)
5. Transactions Chemical Engineering Society Japan (new in 1975)

Direct contact with aerosol researchers in the USSR was not approved by the sponsor; therefore, Soviet reports were collected primarily by searching the following journals:

1. Adv. Aerosol Sci. - Fizika Aerodispersnykh Sistem
2. Chem Pet Eng (USSR) - Khim. Neft. Machinostr.
3. Chem Technol Fuels Oils (Eng. Transl.) - Khim. Tekhnol. Topl. Masel.
4. Colloid J. USSR (Eng. Transl.) - Kolloidn. Zh.
5. Dok Phys Chem (Eng. Transl.) - Dokl. Akad. Nauk SSSR
6. Electr Technol USSR (Eng. Transl.) - Elektrichestvo
7. Ind Lab (Eng. Transl.) - Zavod. Lab.
8. Instrum Exp Tech (Eng. Transl.) - Prib. Tekh. Eksp.
9. J Appl Chem USSR (Eng. Transl.) - Zh. Prikl. Khim (Leningrad)
10. J Eng Phys (Eng. Transl.) - Inzh.-Fiz. Zh.
11. Mendeleev Chem J (Eng. Transl.) - Zh. Vses. Khim. O-va
12. Metallurgist (Eng. Transl.) - Metallurg (Moscow)

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13. Particulate Information - new title Current Awareness in Particle Technology

14. Referativnyi Zhurnal Khimiia - Soviet Abstracts: Chemistry (Section B - Chemistry of Colloids and Dispersion Systems and Section I - Safety and Sanitary Techniques)

15. Refractories (Eng. Transl.) - Ogneupory

16. Sov Chem Ind (Eng. Transl.) - Khim. Prom-st (Moscow)

17. Sov J Non-Ferrous Met (Eng. Transl.) - Tsvetn. Met.

18. Sov Phys Acoust (Eng. Transl.) - Akust. Zh.

19. Sov Phys-Dokl (Eng. Transl.) - Dokl. Akad. Nauk SSSR

20. Sov Power Eng (Eng. Transl.) - Elektr. Stn.

21. Steel USSR - Stal and Izv. Vyssh. Ucheb Zaved., Chern. Met.

22. Therm Eng (Eng. Transl.) - Teploenergetika

About 300 reports each were collected from Japan and the USSR and about 30 each from Australia/New Zealand and Canada. The relatively few unpublished reports in Australia and Canada reflect the limited research and development in air pollution control technology in those countries. Foreign language reports were translated or abstracted, depending on importance. All reports are listed in the bibliography by country under the following subjects:

1. Emission Sources
2. Control Methods
3. Measurement Methods
4. Air Quality Measurements
5. Atmospheric Interaction
6. Basic Science and Technology
7. Effects - Human Health
8. General and Miscellaneous

All reports and abstracts were delivered to EPA for further evaluation. Complete texts of foreign language reports were provided where reports were abstracted (in English) but not translated.

III. NEW CONCEPTS OF FINE PARTICLE CONTROL AND MEASUREMENT

In this study, a "new concept" is defined as an idea that is believed to be unknown to most U.S. workers in the field of fine particle control and measurement.

Eleven new concepts of fine particle control and three new concepts of fine particle measurement are listed below. Most of these concepts are for the modification and improvement of existing methods rather than fundamentally new methods, but all should be carefully evaluated.

A. NEW CONTROL CONCEPTS

1. Spouted Bed Collection of Electrified Aerosols

Balasubramanian, M., A. Meisen, and K. B. Mathur

SPOUTED BED COLLECTION OF SOLID AEROSOLS IN THE PRESENCE OF ELECTRICAL EFFECTS. 15 pages. Presented at the 25th Annual Canadian Chemical Engineering Conference, Montreal, P.Q., Nov 2-5, 1975. (Reference B3)

Solid latex aerosols (0.79 μm dia.) were removed from an air stream by passage through a spouted bed (0.152 m dia.) containing ABS plastic particles (3 mm dia.). A negative corona was used to charge the aerosols and the following variables were studied: corona discharge voltage (0 to 9.5 k V), bed depth (∿0.3 to ∿0.5 m), and gas velocity (∿0.23 to 0.85 m/sec). Spouted bed efficiencies for neutral aerosols ranged from 43 to 63%. Use of a mathematical model suggested that these efficiencies were considerably higher than expected from the diffusional mechanism (inertial impaction being negligible) and that triboelectrification of the bed particles increased the diffusional mass transfer coefficient by a factor of 80 to 170. Collection efficiencies for charged aerosols were 72 to 98% and the corresponding enhancement factors of the mass transfer coefficient were 160 to 2300.

2. Scrubber with Magnetically Pretreated Water

Mikhel'son, M. L., E. M. Belyayev, and N. I. Kirnosova

INFLUENCE OF UNIPOLAR MAGNETIC TREATMENT OF WATER ON COAGULATION OF A DUST AND WATER AEROSOL. Text in English. Colloid J. USSR, 32, No. 6, 738-740, 1970. (Reference D113)

Coagulation of water aerosols and collection of dust particles by sprayed water are increased considerably if the water, flowing at a velocity of 0.07 m/sec, is first treated in a unipolar magnetic field.

In the range of field intensities from 0.4 to $1.2 \cdot 10^5$ At/m the best coagulation effect is achieved at $1.0 \cdot 10^5$ At/m (1250 Oe). The increased efficiency of dust collection by sprayed water previously treated in a magnetic field is due mainly to more effective collection of the finer dust particles by the water drops.

3. Shock-effect Scrubber

Savrayev, V. P. and V. V. Zapasnyy

GAS PURIFICATION IN SHOCK-EFFECT SCRUBBERS. Abstract in English. Tsvet. Metally, No. 5, 29-32, 1975. (Reference D149)

Examination and correlation of the results of a test of shock-effect of scrubber operation in lead-zinc and copper-smelting plants established that these scrubbers basically operate at high efficiency rates by collecting dust having a particle size >2-3 mcm. Optimum work performance and shock-effect scrubber design is tested under these conditions. A design for a centrifugal safety trap of the rosette type (for decreasing spray carry off) is suggested and then tested, with positive results.

4. Foam Scrubber with Pre-electrified Particles

Tarat, E. Ya. and A. I. Volkind

INCREASING THE FRACTIONAL EFFICIENCY OF A FOAM APPARATUS FOR TRAPPING OF DUST WITH PRELIMINARY ELECTRIFICATION OF THE AEROSOL. Abstract and text in English. J. Appl. Chem. USSR, (47), 2181-2182, 1974. (Reference D166)

The increase in fractional efficiency of dust trapping resulting from preliminary electrification of an aerosol is particularly noticeable for fine dust fractions. The increase in effectiveness of precipitation of an electrified particle results from the apparent increase in its inertial path length.

Tarat, E. Ya., A. I. Volkind, Yu. A. Pushkin, and V. K. Abramyan

STUDY OF THE PROCESS OF WET DUST TRAPPING WITH PRELIMINARY ELECTRIFICATION OF AN AEROSOL (USING A FOAM APPARATUS AS AN EXAMPLE). Abstract in English. Issledovaniya Protsessa Mokrogo Pyleulavlivaniya S Predvaritel'noy Elektrizatsiy Aerozolya (Na Primere Prnnogo Apparata), Leningrad, 16 pages, 1974. Referativnyy Zhurnal Khimiya, No. 12, Abstract No. 12I745Dep, 1975. (Reference D167)

Results are presented from studies of a new method of increasing the effectiveness of wet dust trapping by preliminary electrification of the aerosol. A theoretical foundation is presented for the phenomenon of increasing efficiency of dust trapping with preliminary electrification of the aerosol. It is established that the predominant factor is the charge imparted to particles of the aerosol in the charging zone, in comparison with the effect of coagulation of charged particles. The fractional efficiencies of a foam apparatus are calculated for sodium fluorosilicate dust with preliminary electrification and without it, allowing approximate estimation of the effectiveness of dust trapping for dusts of similar properties. The specific charge of the aerosol accumulated in the corona discharge zone is measured, and its variation as a function of dust content and voltage on the corona electrode is determined.

5. Electrified Gas-dispersion Scrubber

Vereshchagin, F. P. and I. M. Vorob'yev

A METHOD OF DUST REMOVAL FROM GASES. Abstract in English. USSR Authors' Certificate No. 428767, Filed 15/03/71, Published 28/10/74. Referativnyy Zhurnal Khimiya, No. 12, Abstract No. 12I741P, 1975. (Reference D183).

A method is suggested for removal of dust from gasses by passing the dusty gasses through a liquid with simultaneous application of an electric field. In order to increase the effectiveness of the process, it is conducted with a current density of 30-200 a/m^2.

6. Electrostatic Regeneration of Fabric Filter

Makino, K., K. Iinoya, S. Toyama, and F. Ikazaki

EXPERIMENTS ON ELECTRICALLY DISLODGING OF DUST LAYER. Abstract in English. Kyoto University. (Reference C31)

A hybrid type of cloth of paper filter and an A.C. electric field barrier was presented. The degree to which the collected dust is removed from the filter surface electrically was assessed experimentally by measuring the pressure drop across the filter before and after dislodging the dust. Results showed that the collected dust on the filter surface is almost completely removed by a strong A.C. (60 H_z) electric field.

The phenomenon mentioned above is quite new in filter dust collection and depends on both the apparent centrifugal force on the charged particles perpendicular to electrostatic force lines between the electrodes of the hybrid filter and a tangential force along those lines. These forces are produced only by an A.C. electric field. With a two-phase source, the dust particles are driven away in a direction perpendicular to the electrode plane, but the motion is parallel to the plane with a three-phase source. In this paper, a new method for dislodging a dust layer from a plane surface by non-uniform A.C. electric field is studied experimentally. It is effective for industrial dusts such as sintering furnace dust and ABS resin powder, especially when corona discharge is applied. The optimum diameter of electrode depends on the distance between dust layer and line electrode surface. The applied frequency should be less than commercial frequency to obtain increased performance.

Kazanskiy, V. V., O. V. Ratiyev, and N. N. Zadira

A METHOD OF REGENERATING FILTRATION MATERIALS. Abstract in English. Soviet patent 385596. Publication date - Dec 20, 1974. (Reference D67)

Presented herein is a method of regenerating filtration materials during gas filtration bearing electrically precharged dust. In order to increase purification efficiency of filtration material cells and to increase their useful life, the material is subjected periodically to an electrostatic charge of the same sign as the charged dust.

Iinoya, K. and K. Makino

DUST COLLECTOR. Text in English. United Kingdom Patent No. 1,357,303. Published 19 Jun 1974. (Reference C14)

Iinoya, K., K. Makino, and F. Igasaki

DISLODGING EXPERIMENT OF ELECTROSTATIC FILTER. Abstract in English. Paper 32, 28 pages, 1975, submitted to Chem. Eng. J. Japan. (Reference C15)

7. Ion-exchange Fabric Filter for Liquid Aerosols and Gases

Khalimon, I. I., A. I. Smushkevich, and Ye. I. Gaponov

USE OF ION EXCHANGE FIBER MATERIALS FOR SEPARATION OF LIQUID AEROSOL PARTICLES IN PURIFICATION OF GALVANIC SHOP EXHAUSTS. Abstract in English. Probl. Okhrany Truda, Kazan', 283-284, 1974. (Reference D68)

Studies have shown that the most effective, reliable and economically expedient method of removal of galvanic shop aerosols from air is the sorption method using synthetic ion exchange fiber materials (IEFM). Due to their high specific capacity in comparison to ordinary physical sorbents, their chemical stability against corrosive media and simplicity of regeneration, IEFM are quite promising for the separation, purification and utilization of the emission product. It is also significant that the capacity of IEFM for various vapor and gas substances amounting some tens of weight percent (in relationship to the weight of the fiber), is practically independent of the concentration of these substances in the gas mixture. IEFM are easily regenerated by methods with or without reagents, producing solutions from which the absorbed substances can be separated to be utilized in a repeat production cycle.

8. Twist Regeneration of Bag Filter

Mitnik, V. L., F. B. Lyutin, and A. S. Mandriko

REGENERATION OF FABRIC IN A SLEEVE FILTER. Abstract in English. Nauch. Tr. N.-I. I Proyekt. In-t Redkomet. Prom-sti., No. 62, 25-28, 1974. Referativnyy Zhurnal Khimiya, No. 15, Abstract No. 15I761, 1975. (Reference D117)

It is established that when sleeves are shaken, the regeneration of the fabric occurs primarily due to deformation of the filter material and only to a slight extent due to inertial forces. Regeneration by deformation of the filter fabric is most effective. Based on this principle, a method of regeneration by reverse twisting of the plugged ends of sleeves is suggested.

Mitnik, V. L. and A. S. Mandriko

INFLUENCE OF HYDRAULIC DRAG OF DUST LAYER ON THE FILTRATION PROCESS WITH REGENERATION OF FABRIC BY THE METHOD OF TWISTING. Abstract in English. Nauch. Tr. N.-I. I Proyekt. In-t Redkomet. Prom-sti., No. 62, 20-24, 1974. Referativnyy Zhurnal Khimiya, No. 15, Abstract No. 15I760, 1975. (Reference D116)

Experiments were conducted using various filter materials and aerosols differing in the concentration and dispersed composition. The methodology of the experiments called for parallel experiments both with regeneration by twisting and with reverse scavenging. In all cases, regeneration by twisting allowed a significant increase in the productivity of a filter without increasing its hydraulic drag. A method of calculation is suggested which can estimate in advance the effect to be achieved from conversion from regeneration by reverse scavenging to regeneration by twisting. If the resistance of the outer layer is significantly greater than the resistance of the inner layer, a greater gain in filter productivity is achieved.

Peisakhov, I. L., V. L. Mitnik, F. B. Lyutin, L. A. Agurenkova, and E. Ya. Dozorets

BAG FILTER WITH FABRIC REGENERATION BY TWISTING THE BAGS. Text in English. Tsvetnye Metally, Soviet J. Non-ferrous Metals, 11 (2), 26-28, 1970 (Reference D126)

Peisakhov, I. L., V. L. Mitnik, Ye. Ya. Dozorets, E. K. Penionzhik, and M. P. Manin

INTENSIFICATION OF BAG FILTER OPERATION. Text in English. Tsvetnye Metally, Soviet J. Non-ferrous Metals, 12, (8), 21-22, 1971. (Reference D127)

9. Three-field, Wet, Tubular Electrofilter

Inyushkin, N. V., N. I. Polyakova, and M. M. Yakovenko

LABORATORY TEST OF A THREE-FIELD TUBULAR ELECTROFILTER. Abstract in English. Tr. Tsentr. N-i. I Proyekt.-konstrukt. In-ta Profilakt. Pnyevmokoniozov I Tekhn. Byezopasn, (10), 118-122, 1974. (Reference D56)

Herein presented are the results of testing of a wet, three-field, tubular electrofilter of industrial dimensions. The level of efficiency (≈ 100%) in the collection of finely dispersed, hazardous silicosis-causing dust in this electrofilter is tied in with the structural features of the device and is due to the intensive, turbulent dispersion of the particles (the inertia effect) and to the efficient combination with the electrical field of an increased intensity in the path of the gas flow. The results of the tests of these elements can be used as the basis for the design of an experimental industrial device.

10. Magnetic Precipitator

Tokyo Roki Kabushiki Kaisha

SEPARATING DEVICE FOR FINE PARTICLES SUCH AS CARBON PARTICLES FROM ENGINE EXHAUST GAS. Text in English. United Kingdom Patent No. 1,329,907. Published 12 Sep 1973. (Reference C70)

This invention is based upon a known phenomenon that an electron (electric charge: — ε coulomb) moving perpendicularly with respect to a magnetic field of a fixed value H gauss at a velocity of v (cm/sec) is given a force f (dyne as follows:

$$f = \frac{1}{10} Hev$$

This force acts perpendicularly to the direction of motion of the electron, so that, without changing the velocity (v), the electron goes away from the magnetic field along a circular path. As the value of the magnetic field increases, the electron will be thrown away from the magnetic field along the circular path.

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16. ABSTRACT

The report presents unpublished fine particulate measurement and control information and information not readily available to the researcher, generated during the period 1971-76 in Australia, Canada, Japan, and the USSR. The information is used as a basis for identifying new concepts in the abovementioned area. Approximately 700 documents are compiled with abstracts. Full-text translations are provided for special-interest areas.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution	Air Pollution Control	13B
Dust	Stationary Sources	11G
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The present invention has utilized this phenomenon in a separating device for carbon or other fine particles charged with electricity in an exhaust gas. Accordingly, the conventional disadvantages experienced with the use of the filter media have been eliminated by the present invention.

Kapustin, E. A., A. M. Kulakov, K. A. Sharapov, V. I. Prosvirinin, and B. Ya. Gritsai

PRECIPITATION OF FERROUS DUST UNDER THE INFLUENCE OF A MAGNETIC FIELD. Abstract and text in English. Ochistka Vod. Vozdush. Gasseinov Predpr. Chern. Met., (1), 105-107, 1972. (Reference D61).

It is often necessary to remove finely dispersed dusts, for example, iron powder, from discharged technological gases. This requires the use of a dry method, since various types of liquids, wetting the precipitation elements of trapping equipment, increase the degree of gas purification, but also limit the use of the trapped dust because of the aggregation of dust particles, their reaction with the liquid medium, etc.

One possible means for solving this problem is the use of magnetic precipitators, using the effects of a magnetic field on the ferromagnetic particles.

A mathematical model of the precipitation of ferromagnetic particles in a non-homogeneous magnetic field was verified experimentally. An increase in particle length by 2 times leads to a decrease in precipitation time by 2.5-3 times.

11. Suppression of Dust Emission with Strong Electrical Fields at High Temperatures

Stark, S. B., N. I. Kharichev, and V. V. Belousov

PROBLEMS OF PREVENTING DUST EXPULSION BY POWERFUL ELECTRIC FIELDS AT HIGH TEMPERATURES. COMMUNICATION 1. Text in English. Steel in the USSR, (4), 937-939, 1974. (Reference D159)

The effect of temperature on the principal processes which take place in electric purification apparatus is analyzed on the basis of existing ideas as to the theory of the electrostatic precipitation of particles. The results of research carried out by the authors of the article in the laboratory with an experimental equipment for purifying gases with a suppressing electric field at up to 550°C are given.

The following basic conclusions can be drawn from the analysis: (i) increase in the temperature of the gas in the region of a corona discharge results in increase in the mobility of the ions and in the corona current, with a simultaneous reduction in the disruptive voltage; (ii) this reduces the time for the charging of particles by the shock mechanism of charging and increases their charge with the diffusion charging mechanism (with the assumptions made); iii) increasing the temperature reduces the rate of drift of particles with dimensions of over 1 μm and increases the rate of drift of particles with dimensions less than 1 μm; (iv) reduction in the specific electrical resistance of dusts with high ohmic values makes it possible to avoid undesirable effects such as a drop in the voltage in the layer of precipitated dust and the reverse corona.

On the basis of these conclusions it can be asserted that, as the temperature rises within particular limits, the effectiveness of the precipitation process in the region of a corona discharge not only is not reduced, but may even become greater.

Stark, S. B. et al

SUPPRESSION OF DUST EMISSION WITH STRONG ELECTRICAL FIELDS AT HIGH TEMPERATURES. COMMUNICATION 2. Text in English. Izvest. V.U.Z. Chernaya Met., (3), 179-182, 1975. (Reference D160)

As already noted, investigations are proceeding at the Moscow Steel and Alloys Institute on the possibility of applying a suppressing electric field at temperatures of up to 500°C of the gas being cleaned. The suppressing electrical field in the given case provisionally indicates one whose voltage vector E lies along the gas stream. A characteristic example of the working of a suppressing field is gas cleaning in the corona-discharge field of a system of "point" - "plane" electrodes on condition that the "plane" consists of a mesh through which the dusty gas passes counter to the point.

The given electric field can be used for reducing dust emission from mechanical-cleaning plant (e.g. a granular filter) or directly from the process plant (e.g. to suppress emission of dusty material from non-ferrous metallurgy furnaces), and also for the preliminary treatment of dusty gas, o.e. enlargement of particles, their charging and partial reduction in concentration before the gas-cleaning plant.

The aim of the present investigation did not include the development of an industrial design to function by the method of reducing dust emission with a suppressing electrical field. However, the results given in the article can be taken as the basic starting data for designing industrial plant operating at gas temperatures up to 500°C.

B. NEW MEASUREMENT CONCEPTS

1. Particle Mobility and Mass Measurement by Sound Waves in Electrical Fields

Epshtein, E. M.

INTERACTION OF AEROSOL PARTICLES WITH A SOUND WAVE IN THE PRESENCE OF A HIGH-FREQUENCY ELECTRICAL FIELD. Text in English. Colloid J. USSR, 32, No. 4, 530-531, 1970. (Reference D209)

The effect of a high-frequency electrical field on the interaction between particles and a sound wave for $\omega \ll \Omega$ leads to renormalization of the interaction constant $A — AJ_0(a)$. This small external change has an interesting consequence: values such as the flux of charged particles caught in the sound wave, the coefficient of sound adsorption (scattering) by these particles, etc., are in effect proportional to A^2. Hence, since these values are also proportional to $1_0^2(a)$ they should depend on amplitude and frequency of the electrical field, which means they should oscillate. Measurements of the oscillatory period will yield information on the mobility and mass of the aerosol particles.

2. Low Pressure Centrifugal Aerosol Spectrometer

Iinoya, K. and Z. Tanaka

PARTICLE SIZE CLASSIFICATION BY DEPOSITION ANGLE IN A REDUCED PRESSURE CENTRIFUGE. Text in English. U.S.-Japan Particulate Technology Seminar, Kyoto, Oct 1969. (Reference C86)

The particle trajectories under the forced vortex conditions in a gas centrifuge are influenced by the pressure as well as many other factors, and this effect is especially remarkable in reduced pressure range. It is therefore expected to achieve the classification of submicron particles by use of reduced pressure. In this paper, the experimental results were compared with the theoretical calculation at various pressure and with glass beads, zinc powder, and monodispersed latex as the particles.

Iinoya, K., Z. Tanaka, and H. Takai

PARTICLE SIZE ANALYSIS WITH A GAS CENTRIFUGE AT REDUCED PRESSURES. Abstract in English. Kagaku Kogaku, 35, No. 9, 1041-1046, 1971. (Reference C87)

The continuous gradation of particle size which occurs on the rotor wall of a gas centrifuge was applied to the analysis of particle size.

As a result of the comparison with other methods of size analysis, it is apparent that this type of centrifuge is an effective dry particle size analyzer. At pressures of less than 20 mm Hg, the equations of motion can be expressed in terms of a dimensionless parameter S, and the computed values of the deposition angle coincided with the experimental results. Moreover, the calculating method of the size distribution has been simplified by the use of the two nomographs proposed here.

3. Particle Concentration Measurement at High Temperature by Thermal Radiation

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MEASUREMENT OF CONCENTRATION OF SOOT PARTICLES ACCORDING TO THEIR RADIATION. Text in English. Thermal Engineering, 21, No. 4, 56-58, 1974. (Reference D231)

The concentration of soot particles μ_s in different zones of a combustion chamber is an important characteristic of furnace processes. Thermal radiation of a luminous flame depends on soot concentration, and the value of μ_s at the end of the combustion zone unambiguously characterizes the unburnt carbon of the fuel.

Measurement of concentration of soot particles according to their radiation is the simplest method of finding their concentration. However, the shortcoming of this method is the considerable dependence of the useful signal on the temperature of the dispersed medium.

In order to considerably reduce the influence of temperature on error in determination of $\mu_{s.n.}$ according to radiation of soot particles measurement must be carried out in the region $\lambda T > 10^4$ $\mu \cdot K$

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1. EMISSION SOURCES

Information pertaining to an industry, process, or material associated with air pollution. Documents in this category are concerned primarily with characteristics of a specific class of emission sources including types, rates, industries; secondary coverage may include effects, control methods, etc.

2. CONTROL METHODS

Includes equipment and both specific source control and general abatement efforts. Included are documents describing the operating principles, design, operation, efficiency, etc., of equipment and methods of removing pollutants. The scope of the document can vary from a device for a specific source to an approach applicable to an entire industry—e.g., automobiles.

3. MEASUREMENT METHODS

Includes equipment as well as methods. Confined to development testing and evaluation of pollutant determination methods (sampling, analytical, monitoring) and equipment, as such. Data obtained by use of methods in specific applications are placed in the applicable subject categories.

4. AIR QUALITY MEASUREMENTS

Pollution measurements in the ambient air, generally related to specific geographical locations, such as area surveys. Also includes general reviews of area situations and emission source inventories.

5. ATMOSPHERIC INTERACTION

All chemical and physical phenomena occurring in the atmosphere. Included is material on dispersion, air pollution forecasts, meteorological effects, topographical effects, photochemical reactions in the atmosphere, etc. Laboratory studies of photochemical reactions are assigned to Basic Science and Technology.

6. BASIC SCIENCE AND TECHNOLOGY

General discussions or data compilations for the basic physical and chemical properties of pollutants. Theoretical and laboratory studies on related chemical and biological reactions and mechanisms. Mass transfer and other basic knowledge related to process engineering applications in emission control or abatement. Excludes photochemical studies in the atmosphere and biochemical studies related to effects of air pollution.

7. EFFECTS--HUMAN HEALTH

Covers medical and epidemiological studies; biological effects other than those on plants and livestock produced by air pollutants; laboratory animal experiments.

8. GENERAL AND MISCELLANEOUS

Reviews of general problems, trends and background. Documents not assignable to other categories.

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